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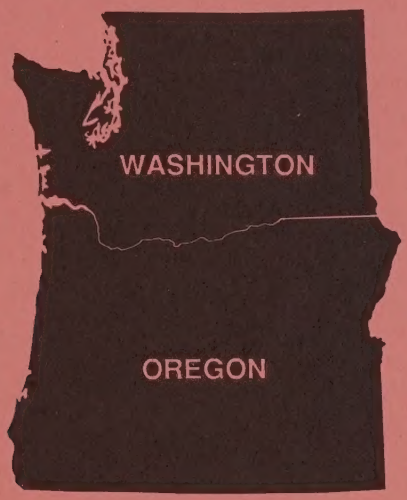
Project Report



1993 Warm Springs Indian Reservation Western Spruce Budworm Suppression Project

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1993 WARM SPRINGS INDIAN RESERVATION

WESTERN SPRUCE BUDWORM SUPPRESSION PROJECT

JAMES S. HADFIELD
INCIDENT COMMANDER
USDA FOREST SERVICE - FOREST PEST MANAGEMENT
PORTLAND, OREGON

TABLE OF CONTENTS

1993 WARM SPRINGS INDIAN RESERVATION
WESTERN SPRUCE BUDWORM SUPPRESSION PROJECT

INTRODUCTION

Western spruce budworm (*Choristoneura occidentalis* Freeman) populations have been at outbreak levels on portions of the Warm Springs Indian Reservation in central Oregon since the mid-1980's. Defoliation caused by the budworm outbreak, in combination with impacts from several other pests, drought, and other stress factors, was starting to result in declining forest health. There was concern that if the outbreak was left untreated it could adversely affect timber production and other forest resources used by the Confederated Tribes of Warm Springs.

Approximately 186,000 acres of the Warm Springs Indian Reservation were sprayed with *Bacillus thuringiensis* variety *kurstaki* (Btk) in 1988 to suppress outbreak populations of western spruce budworm. Populations were reduced to less than 1 budworm per midcrown branch for the analysis unit. Not all of the areas with outbreak populations were included in the 1988 spray project. Defoliation caused by budworm remained low in most of the sprayed area for about 3 years. Defoliation continued in many of the areas not included in the 1988 project. Some of the areas sprayed in 1988 experienced resurgence of the budworm populations with defoliation becoming visible in 1991. In 1992 visible defoliation expanded to encompass approximately 60,000 acres.

In 1992, the U.S. Department of Interior, Bureau of Indian Affairs, Branch of Forestry at the Warm Springs Agency (BIA), established 3 budworm analysis units on the reservation to estimate budworm population levels, and assess the effects of the outbreaks and management alternatives on resource management. Biological evaluation of the budworm infestations in the analysis units done in the summer of 1992 predicted that population densities in 1993 would cause light to moderate defoliation (Eglitis, A., 1992. Biological evaluation of western spruce budworm and Douglas-fir tussock moth in proposed 1993 analysis units on the Deschutes National Forest - Sisters RD, Willamette National Forest - McKenzie RD, and Warm Springs Indian Reservation. Rep. R6-CO-92-1 USDA-Forest Service, Deschutes National Forest, Bend, OR, 29 p.)

The BIA prepared a site-specific Environmental Assessment, "Environmental Assessment for the Western Spruce Budworm Spray Project". The alternative selected in the EA was to suppress the budworm population on approximately 60,000 acres in three analysis units with the biological insecticide *Bacillus thuringiensis* variety *kurstaki* (Btk). A Decision Notice and Finding of No Significant Impact was signed by the Superintendent of the Warm Springs Agency, BIA on January 29, 1993.

The Tribal Council of the Confederated Tribes of Warm Springs passed Resolution 8578 authorizing the BIA to suppress the outbreak with Btk insecticide.

The BIA requested the Forest Service do the contracting for the suppression project and to provide an Incident Command System team to manage it.

OBJECTIVE

The objective of the suppression project was to safely, efficiently, and economically reduce the western spruce budworm populations within the treatment areas to levels that would not cause additional, unacceptable resource damage for several years. The suppression target goal for each analysis unit was to reduce the budworm population by 90 percent, unadjusted for natural mortality, in the time period from the prespray sampling to the postspray sampling.

PROJECT AREA

The suppression project was done in stands with large proportions of western spruce budworm host species; Douglas-fir, grand fir, and noble fir. Practically all stands had at least 30 percent of their stocking in primary budworm host tree species. The project was separated into three analysis units for purposes of entomology sampling and analysis. The general vicinity map (Figure 1) shows the location of the analysis units. The following paragraphs describe the general location and characteristics of the analysis units:

- Lionshead: This analysis unit was located on the southern most part of the Reservation. The southern boundary is the Metolius River and Jefferson Creek. Lionshead contained 22,842 treatment acres. Elevation in the unit ranges from 2400 to 6000 feet above sea level. Terrain varies from gentle rolling to extremely steep.

- Badger Butte: The unit had 17,804 treatment acres. Elevation ranges from 3300 to 5600 feet. Badger Creek, Mill Creek, and Shitike Creek originate in the unit. Terrain is generally moderate.

- Mt Wilson: The analysis unit is located in the northwestern portion of the reservation. It contained 22,536 acres. This unit has several thousand acres of noble fir stands, however, Douglas-fir and grand fir were the most common species. Elevation ranges from 3300 to 5600 feet. Terrain is generally moderate throughout.

The treatment units were divided into 102 spray blocks, based on host type, topography, and elevation.

PROJECT ORGANIZATION

An Incident Command System organization, modified to fit the needs of a forest defoliator suppression project, was used to manage the project. The organization is displayed in Figure 2. A total of 37 Forest Service, Warm Springs Tribe, Bureau of Indian Affairs, and Bureau of Land management personnel worked on-site on the project. Resource orders for all personnel were issued by the Warm Springs Fire Dispatch Office. The contractor had about 30 employees on site.

CONTRACTING

Evergreen Helicopters, Incorporated, from McMinnville, Oregon was the contractor.

The Forest Service used a Request For Proposals (RFP) to solicit, negotiate, and award the contract. Items contracted for were application aircraft and support equipment and personnel, sufficient Btk insecticide to spray 64,000 acres, marking of project block boundaries, application of insecticide, and observation helicopters and pilots certified to transport government employees.

The contract specified that any of three commercially available Btk products could be used on the project. The three products were Thuricide 48LV, Foray 48B, and Dipel 6AF. All application was to be at the rate of 1/2 gallon of undiluted insecticide per acre. This equated to 24 billion international units per acre of active ingredient.

Four aerial applicators responded to the RFP with technical and price proposals. Evergreen was awarded the contract for the project on the bases of technical approach and price. The contract was awarded at the price of $10.27 per acre.

Evergreen provided 2 Lama 315Bs, 3 Bell 212s, and 1 Bell 205 helicopters for application. The observation helicopter fleet consisted of 3 Bell 206 BIII Jet Rangers and 1 Lama 315B.

Evergreen sprayed Dipel 6AF, supplied by Abbott Laboratories.

FACILITIES AND EQUIPMENT

The Government set up an administrative office and technical center at the Warm Springs Industrial Park complex in Warm Springs, Oregon.

A large quantity of supplies and equipment needed for the project was resource ordered from the Forest Pest Management suppression cache and the National Fire Equipment System cache at the Redmond Air Center. Several incidental supplies were purchased locally. A radio system was ordered from the National Inter-Agency Fire Center.

Evergreen established an office at Madras, Oregon. Several temporary helispots were located throughout the project area.

SPRAY OPERATIONS

Spray blocks were delineated by the Forest Service. Elevation range, slope, and continuity of host type were the main factors used to define blocks.

The entire project was restricted to helicopter application. Although some of the terrain was suitable for application by airplanes, the acreage was so small as to not be worthwhile to use them.

Spray blocks were marked for spraying by placing bright orange, yellow-green, and white streamers in snags and tall trees along the boundaries. This was done by contractor personnel tossing markers from helicopters. Ground panels and distinctive ground features were used as aids in marking blocks.

Spray aircraft were calibrated and characterized at McMinnville, Oregon. A SwathKit was used to measure and analyze the spray patterns created during the characterization spray runs. Each aircraft made at least two characterization runs. The Lama 315Bs were calibrated for a swath width of 100 feet and a flow rate of 8.1 gallons per minute with the application speed of 80 MPH. The two Lamas were fitted with six Beecomist 360 atomizers. The Bell 205 and Bell 212s were calibrated for a swath width of 130 feet and a flow rate of 13.1 gallons per minute at the application speed of 92 MPH. These four helicopters were fitted with 8 Beecomist 360 atomizers. All application aircraft were equipped with Crophawk flow meters. Application aircraft had to produce a spray pattern that averaged at least 20 drops per square centimeter and the VMD had to be within the range of 75 microns to 150 microns. All aircraft met the contract spray pattern specifications.

Dipel 6AF was delivered to the contractor in bulk truck tanker shipments. The insecticide was off-loaded into batch trucks. The batch trucks were positioned at several helispots throughout the project area. No dye was added to the insecticide, except for the characterization inspections. Insecticide was metered by the contractor and monitored by the Government when it was pumped from batch trucks into the application aircraft. The contractor was paid on the basis of gallons of insecticide pumped into the aircraft and then applied as called for in contract specifications.

Application and observation pilots and Government aerial inspectors flew over the spray blocks prior to their scheduled treatment to familiarize themselves with block features and determine spray tactics.

The application aircraft flew in teams of two or solo, accompanied by a single observation helicopter. Spraying was allowed only when observation helicopters were present. Spray and observation aircraft, ground equipment, and personnel were formed into teams that operated together throughout most of the project. Evergreen was responsible for assigning specific aircraft to the spray blocks.

The following criteria had to be met before spraying could proceed: wind speed between 1 and 6 MPH, relative humidity greater than 55%, temperature between 33 and 70 degrees, no drops of water on the foliage, and no rain predicted to fall within 6 hours of spraying.

Ground-based observers monitored weather in the spray blocks the morning they were scheduled for spraying. Wind speed, wind direction, temperature, and relative humidity were measured and radioed to the project headquarters and helispots.

Ground observers placed white Kromekote cards in lines in some spray blocks to monitor spray deposit. Cards were placed at least one full tree height away from trees, where possible. The number of cards per line varied from 5 to 20. All cards were placed on the ground in plastic holders. Spray drops seen within two 1 square centimeter fields predrawn on the cards were counted by the ground observers using dissecting microscopes.

Spray blocks were to be sprayed within 72 hours of being released or they would be temporarily withdrawn until another prespray budworm larval sample was taken. In the course of the project only one spray block was prespray sampled twice.

A daily shift plan developed by the Government and the contractor documented the aircraft, personnel, and radio channels to be used by each spray team to accomplish spraying the released blocks. Treatment priorities were assigned to spray blocks. A daily safety message was attached to the shift plan.

Pilots and aerial observers reviewed their assignments each morning prior to begining spraying. All aircraft reported their locations to the project dispatcher or application equipment managers at least every 15 minutes when flying.

ENTOMOLOGY OPERATIONS

The entomology section consisted of one entomologist, three experienced assistants, and six technicians.

The tasks of the entomology operations were to determine when the spray blocks should be released for spraying to optimize treatment effectiveness, and to sample and estimate the budworm population before and after spraying.

A minimum of 30 budworm density sampling plots were established within each analysis unit. These plots were accessible from roads, but far enough away to avoid excessive exposure to dust. Every spray block did not have a sampling plot, some had more than one. The plots were distributed throughout the analysis units. A plot contained five open grown Douglas-firs or true firs, 20 to 50 feet tall. Only one tree species was represented in each plot. The same trees were used for both prespray and postspray sampling.

Larval and tree development were monitored to determine when individual spray blocks met release criteria. Blocks were supposed to be released for spraying when the first sixth instar larva was seen and at least 95 percent of all new

shoots had unfurled (i.e., the budcap was gone and the new shoots elongated so the needles were no longer bunched). This was modified on the project to release blocks when less than 15 percent of the sampled larvae were still in the second and third instars and at least 95 percent of the shoots had unfurled. Development monitoring involved assessing larvae sampled in lower crowns and shoots by visual estimate within each accessible spray block. Monitoring was prioritized by looking at low elevations-southern exposures first and high elevations-northern exposures last. Those blocks with no road access were released for spraying when adjacent blocks with the similar elevation and aspects met release criteria or a visual survey from a helicopter observer confirmed foliage readiness.

Budworm density plots in spray blocks were sampled 16 to 24 hours before the first day the blocks were available for spraying. Three, approximately 18 inch long lower crown branch tips from each of the five plot trees were beaten over a beating cloth/frame, then they were cut and discarded to prevent their being sampled again. All budworms on the cloth were counted and the instar of each determined.

The postspray budworm density sample was taken in each evaluation plot no sooner than 14 days and no later than 21 days after the block had been sprayed. The sampling procedure was the same as that used for the prespray sampling.

All lower crown population sample data were converted to mid-crown branch tip equivalents using the equation $Y = .3513 + .6781X$ where Y = mid-crown branch tip budworm density and X = budworm density of the 3 branch lower crown sample (Torgersen,T.R., D.W. Scott, T.F. Gregg, and K.P. Hosman [In Preparation] Sampling western spruce budworm, *Choristoneura occidentalis* Freeman [Lepidoptera: Tortricidae] by lower-crown beating after treatment with *Bacillus thuringiensis* Berliner). There was no sampling of mid-crown branch tips.

SPRAY OPERATIONS ACCOMPLISHMENTS

Analysis unit treatment data are displayed in Table 1 (Appendix). A total of 64,182 acres were sprayed. Insecticide application began on June 19 and was finished on July 7. Three days were not suitable for spraying because of wind, rain, or fog.

The contractor used 73 percent of the time that was available for spraying. Available time is defined as times when conditions are suitable for spraying and acreage is available to be sprayed. Several equipment malfunctions contributed to the failure to use more of the available spray time. The application fleet of 6 helicopters averaged 1426 acres sprayed per flight hour. Long ferry times were a contributing factor to the low production. Data for the individual application helicopters are displayed in Table 2 (Appendix).

A total of 305.3 flight hours were flown on the project.

Fifty five card lines, with a total of 734 spray cards, were placed in 39 spray blocks. Spray drops were seen on 91 percent of the cards and drop density averaged 9.0 drops per square centimeter. The percentage of cards with measured spray and spray drop density varied substantially by the four different application teams.

No handling problems were experienced with the insecticide.

ENTOMOLOGY SAMPLING RESULTS

A total of 107 5-tree budworm density plots were used for prespray and postspray sampling.

Population sampling results are displayed for the analysis units in Table 3 (Appendix) and Figure 3. Graphic displays of prespray and postspray population densities from the lower crown branch sampling for each analysis unit are shown in Figures 4 to 6. All project entomology data are on file at the Forest Pest Management office in Portland, Oregon.

BUDGET

Cost of the project was $862,000. Cost per sprayed acre averaged $13.43. A breakdown of costs is shown in Table 4 (Appendix). The contract accounted for $10.27 per acre, with administrative costs an additional $3.16 per acre. All costs of spraying were paid by the Federal government.

SAFETY

There were three reported vehicle accidents on the project. None were considered serious. Driving on dusty roads in the dark was one of the most hazardous activities on the project. Approximately 12,000 miles were driven by project personnel. One person suffered a tick bite. There were no reported spills. Several aircraft incidents were reported. They are summarized in Table 5 (Appendix).

DISCUSSION

In the course of establishing the budworm sampling plots in the project area, it became obvious that the budworm population density had dropped substantially from levels seen in 1992 for the same area. A portion of the Lionshead analysis unit that appeared to have a low budworm population was sampled by lower crown beating to estimate population density. This was done to help decide whether to eliminate parts of the project area from spraying or to continue. The budworm population within the area subsampled averaged slightly more than 3 larvae per 3 lower crown branch sample per tree. Subsequent prespray sampling for the entire Lionshead unit gave an average of slightly more than 5 larvae per 3 lower crown branch sample per tree. The BIA decided to proceed with the spraying. The BIA believed that, even though the budworm population was low, spraying offered the potential of having several years of reprieve from defoliation. There was concern that without spraying, the population could rather quickly resurge and cause serious defoliation.

The western spruce budworm populations on the Warm Springs Indian Reservation and most of eastern Oregon and Washington experienced large declines from 1992 to 1993. The amount of defoliation caused by budworm feeding dropped dramatically over this period. The reasons for the decline are not clearly known, but are likely a combination of unfavorable weather for budworm survival, increase in parasites and predators, starvation, and other factors. There may be relatively small areas of budworm caused defoliation on the Warm Springs Reservation and adjacent areas, but it is likely there will not be extensive severe defoliation for at least a few years.

The ICS organization and approach used to manage the project was effective. Administrative costs were low. Use of Reservation facilities and Tribal employees for many project positions helped hold down costs. The negotiated contract process resulted in obtaining the services of a firm with several years experience spraying Pacific Northwest forests. The safety record of the project, which had a high potential for accidents, was good.

APPENDIX

Table 1. 1993 Warm Springs Indian Reservation western spruce budworm suppression project analysis unit treatment information.

Analysis Unit	Number Spray Blocks	Acres Sprayed
Badger Butte	42	17,804
Lionshead	36	22,842
Mt Wilson	24	23,536
Total	102	64,182

Table 2. Production data for the application helicopters used on the 1993 Warm Springs Indian Reservation western spruce budworm suppression project.

Aircraft	Model	Days Used	Flight Hours	Acres Sprayed	Av. Acres/Hour
N4750R	Bell 205	8	16.8	12,764	760
N16974	Bell 212	12	19.9	11,090	557
N3599D	Bell 212	14	26.0	11,960	460
N5017H	Bell 212	9	16.2	9,832	607
N59633	Lama 315B	10	18.9	11,714	620
N55963	Lama 315B	11	17.2	6,822	397

Table 3. 1993 western spruce budworm population densities for the Warm Springs Indian Reservation analysis units.

Analysis Unit	No. Plots	BUDWORM DENSITY (Mean and SE)* Budworms per 3-branch Lower crown sample	Budworms per 18-inch Mid-crown branchtip**
Prespray			
Badger Butte	35	10.0 + 1.4	7.1
Lionshead	37	5.1 + 0.6	3.8
Mt Wilson	35	4.3 + 0.8	3.3
Postspray			
Badger Butte	35	0.7 + 0.1 (93)***	0.8 (89)
Lionshead	37	0.3 + 0.1 (94)	0.5 (87)
Mt Wilson	35	0.6 + 0.2 (86)	0.8 (76)

* Standard Errors (SE) could not be reported for converted midcrown means.

** Predicted budworm density per 18 inch mid-crown branch tip derived by converting measured lower crown branch densities using the equation
Y = .3513 + .6781X. (Torgersen et.al. In Preparation)

*** Numbers in the parenthesis are percent population declines estimated from prespray sampling to postspray sampling.

Table 4. Budget for the 1993 Warm Springs Indian Reservation western spruce budworm suppression project.

Salaries and Per Diem	Tribal	$44,200
	BIA	$18,930
	USFS	$90,000
Application Contract		$661,075
Vehicles		$15,500
Supplies, Services & Equipment		$32,395
Total		$862,000

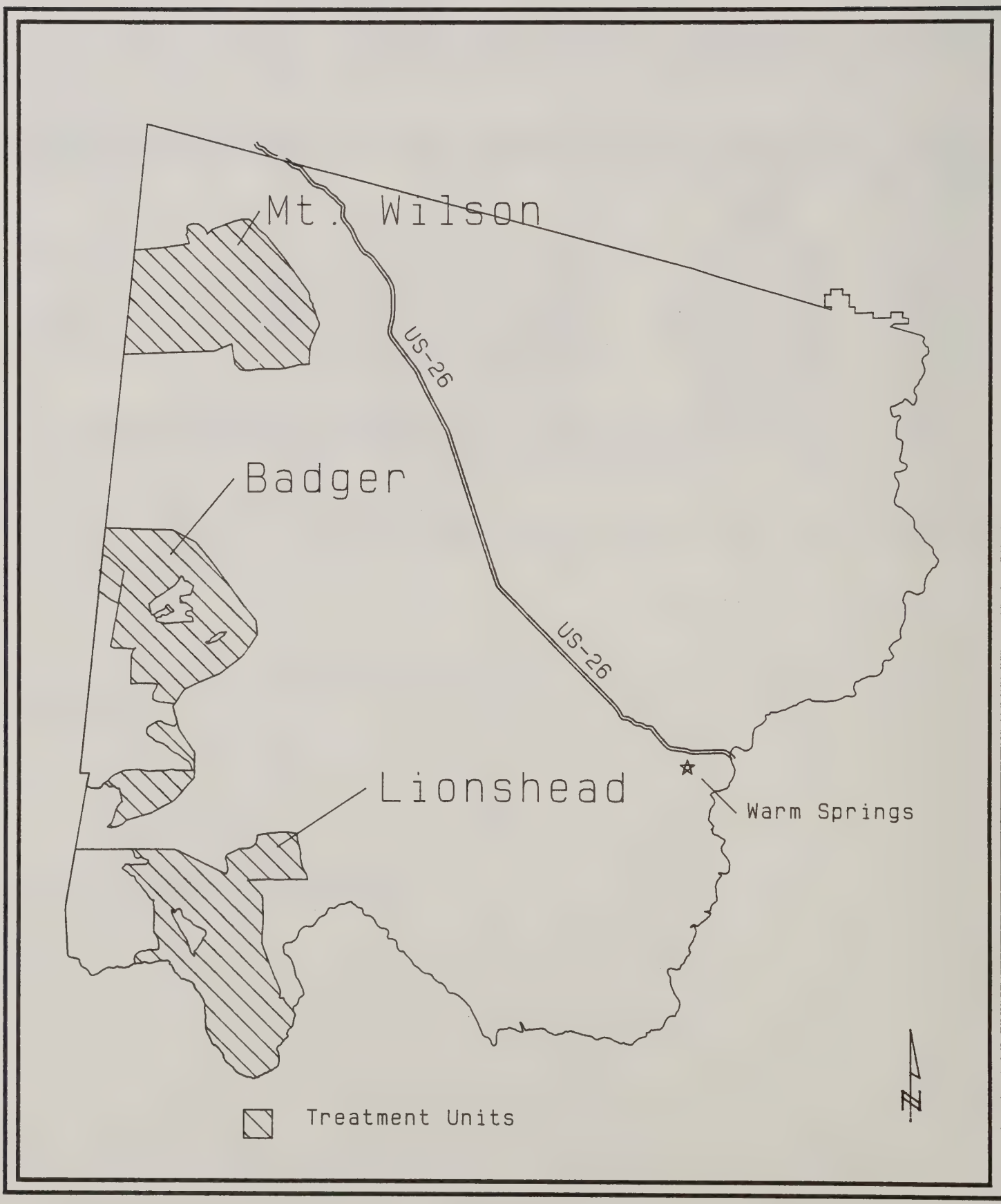
Table 5. Summary of aircraft incidents reported on the 1993 Warm Springs Indian Reservation western spruce budworm suppression project.

Aircraft	Type	Incident
N 18FH	Bell 206 BIII	Main rotor blade strike
N 18FH	Bell 206 BIII	Hydraulics circuit breaker tripped
N55963	Lama SA-315B	Spray boom vibration/rotor head vibration
N55963	Lama SA-315B	Feedback in collective control system
N 82FC	Bell 206 BIII	Oil temperature guage malfunction
N 82FC	Bell 206 BIII	Transmission oil leak
N 18FH	Bell 206 BIII	Turbine outlet temperature guage max-out
N16974	Bell 212	Rotor tiedowns unhooked in high winds on ramp

Figure 1

1993 Warm Springs Indian Reservation

Western Spruce Budworm Suppression Project



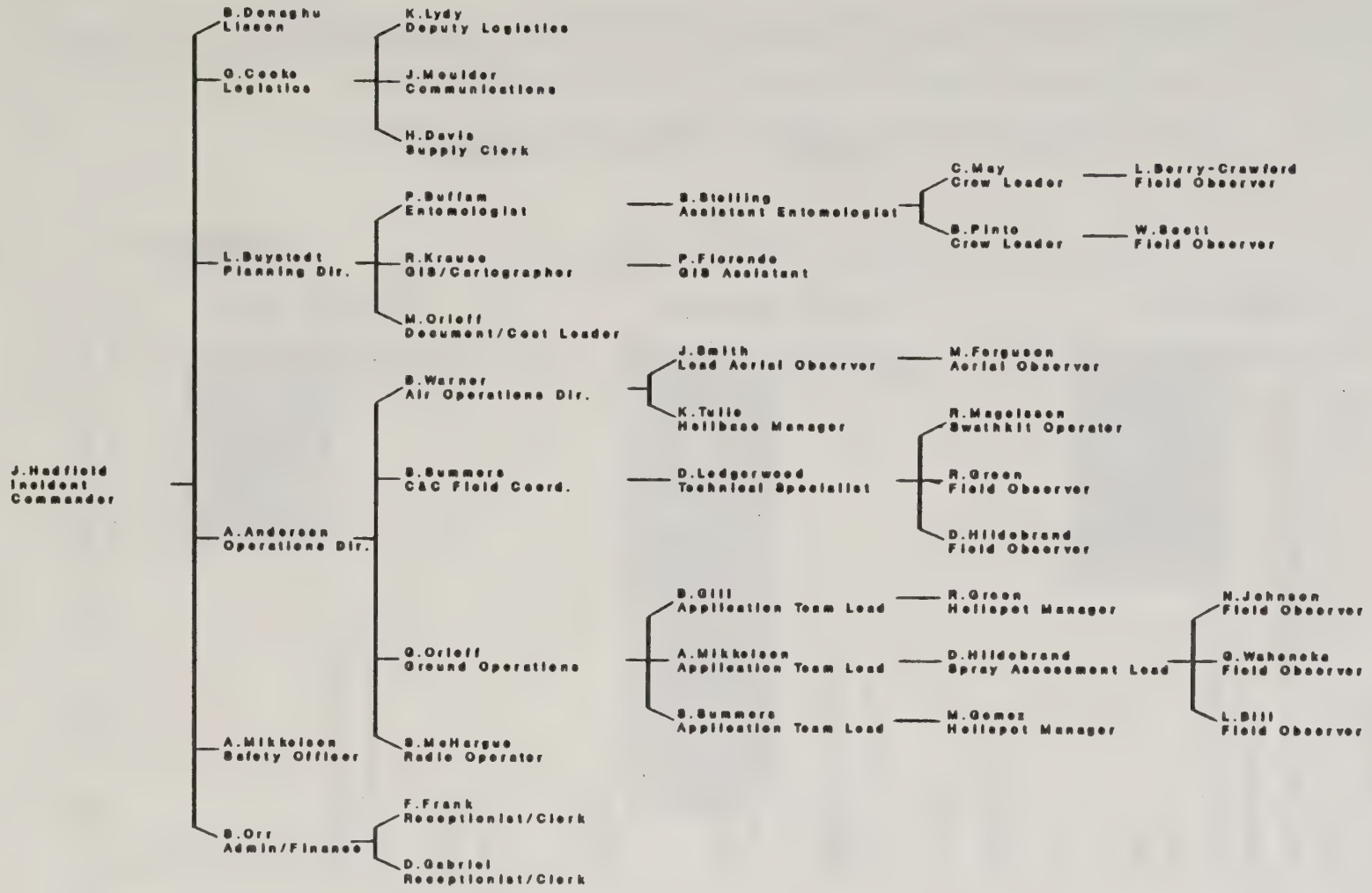
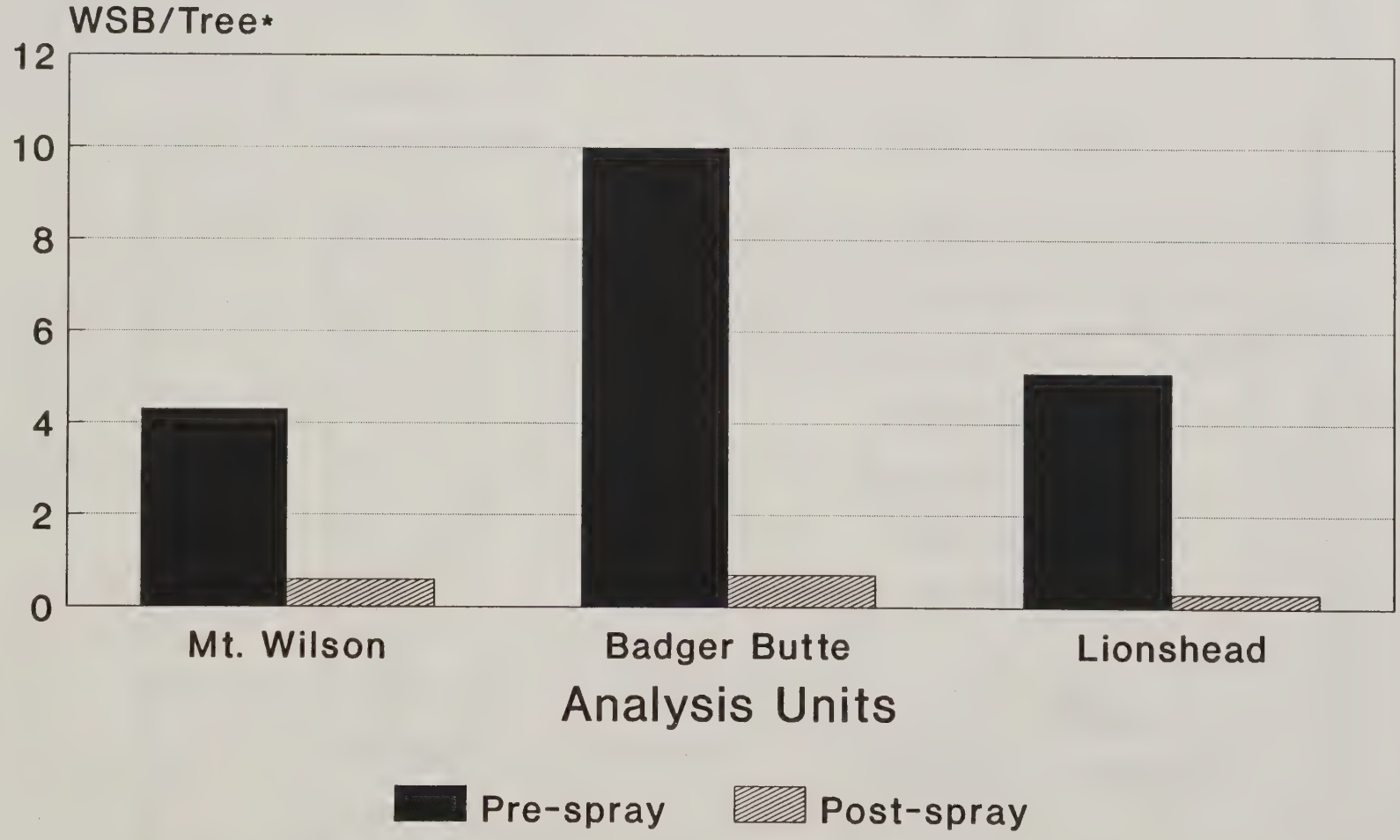


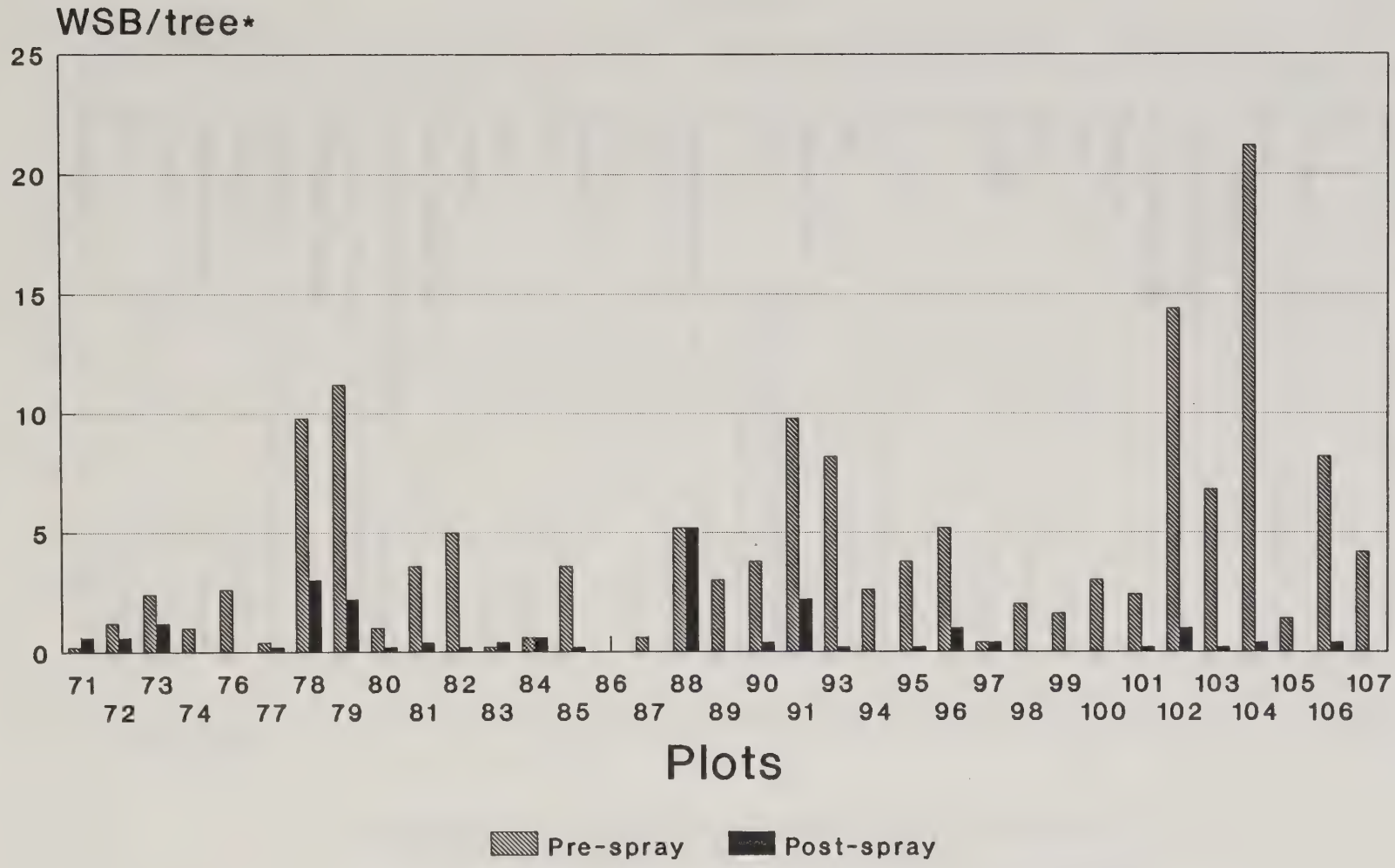
Figure 2. 1993 Warm Springs Indian Reservation
Western Spruce Budworm Suppression Project Organization.

Figure 3. Average western spruce budworm lower crown branch densities for the 1993 Warm Springs Indian Reservation analysis units.



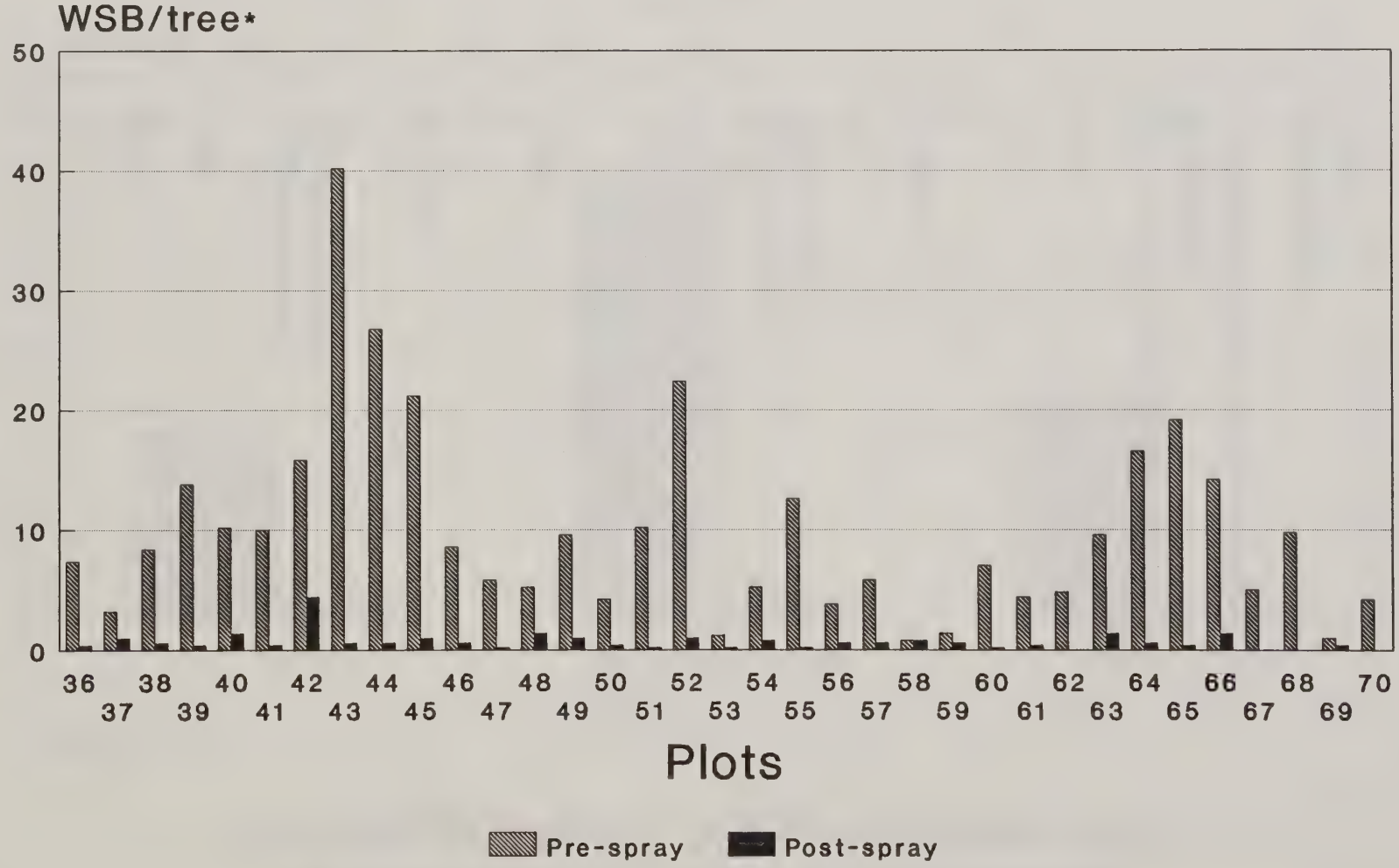
* 3 lower crown branches per tree

Figure 4. Western spruce budworm plot densities from lower crown branch samples in the Mt. Wilson analysis unit.



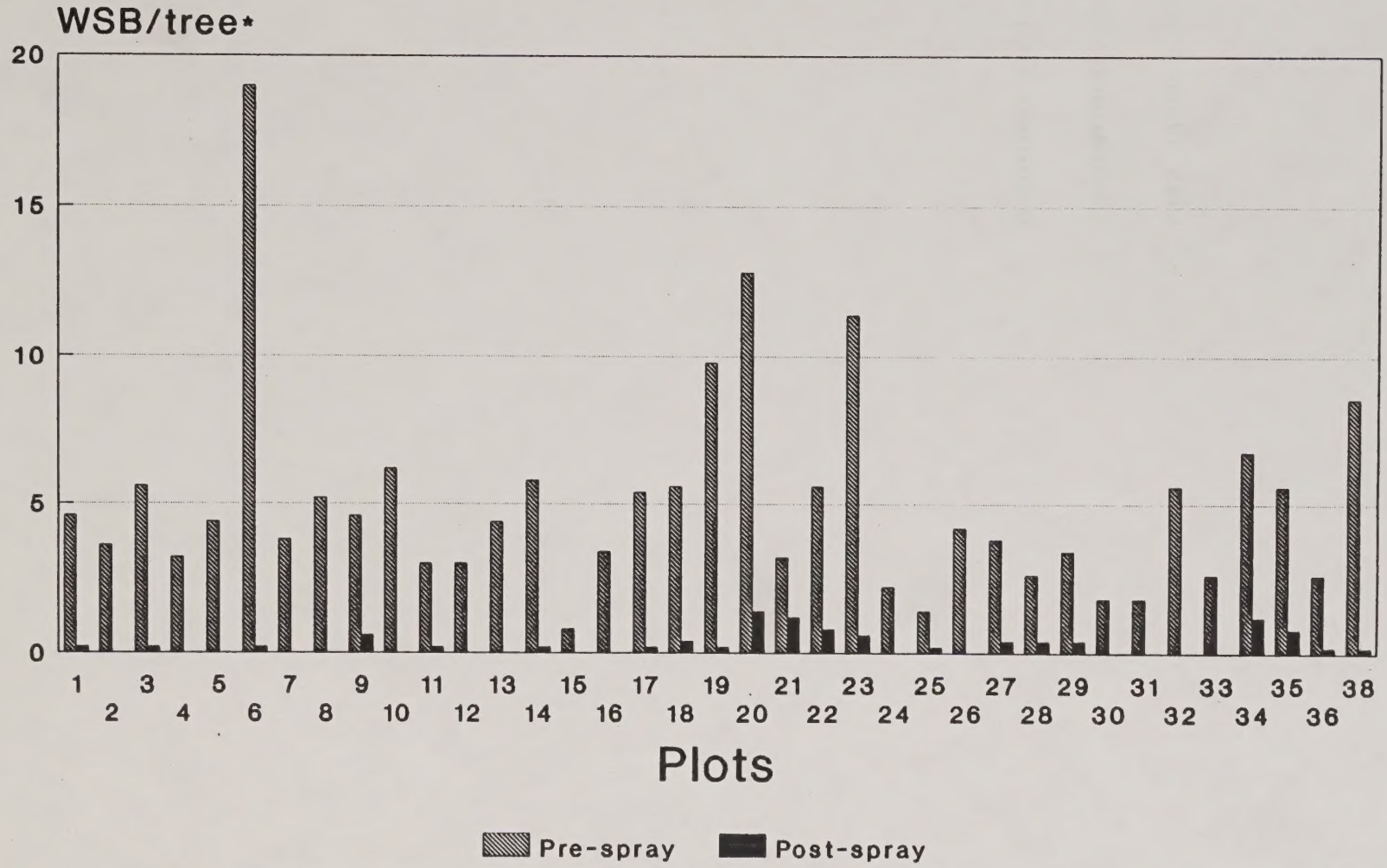
* 3 lower crown branches per tree

Figure 5. Western spruce budworm plot densities from lower crown branch samples in the Badger Butte unit.



* 3 lower crown branches per tree

Figure 6. Western spruce budworm plot densities from lower crown branch samples in the Lionshead analysis unit.



* 3 lower crown branches per tree

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